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(54) Traffic information inter-vehicle transference and navigation system

(57) In a system for transference of traffic information among vehicles and navigating the vehicles, traffic information of the vehicles, such as the speed and the path, is remotely transmitted to each other during passing by. The apparatus comprises sensors to detect the direction and the displacement of the vehicle; a microcomputer to recognize the position of the vehicle by referring the detected direction and displacement to a digitized map; a receiver to receive passing-by vehicles' traffic information to be processed by a microcomputer; a transmitter to transmit traffic information to passing-by vehicles; and a navigation unit in the microcomputer to generate navigation information which is displayed for the driver.
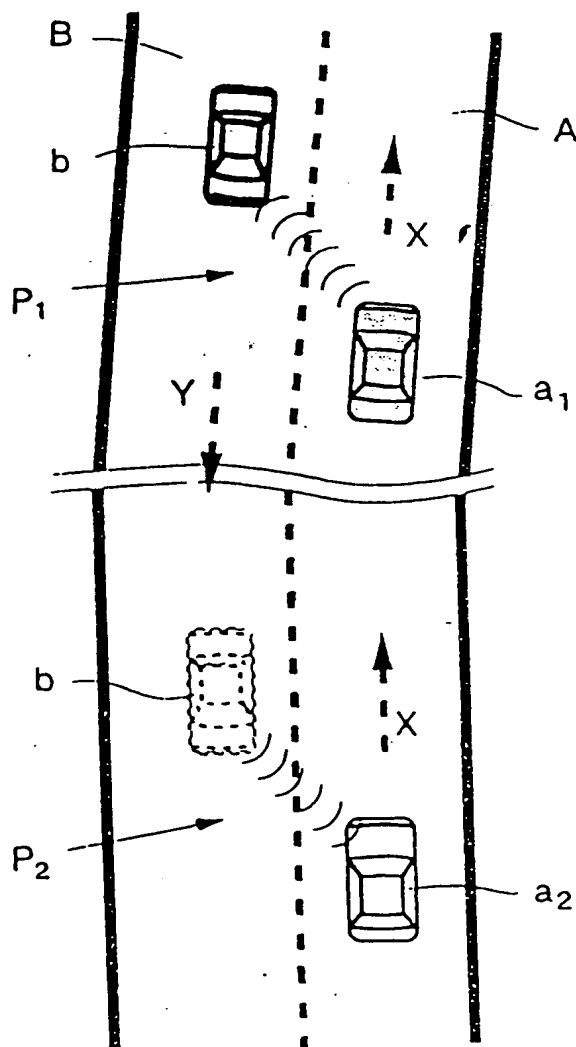
FIG. 1

TRAFFIC INFORMATION INTER-VEHICLE TRANSFERENCE AND NAVIGATION
SYSTEM

This invention relates to a method and an apparatus
for a vehicle to get traffic information and using the
information to navigate. The characteristic of this invention
is that a vehicle acquires the information of traffic status
in front of it by means of information transference from the
passing-by vehicles.

Some of the prior vehicle navigation systems,
presently available or under development, use satellites
which allow the vehicles to identify their present location,
while they do not provide traffic information. other
navigation systems, using a central computer to provide
traffic information for vehicles, communicates with the
vehicles through signal posts allocated along the roads.
Because these systems have to build transceiver posts at many
adequate locations (such as each intersections), the vehicles
that are not at the right location (such as while blocked
between the intersections) can not receive the information,
and only an urban area in a light traffic condition can use
them and works well.

This invention, in order to solve the problems
mentioned above, provides a method and an apparatus for
transference of traffic information among vehicles and

navigating the vehicles, and does not need any central computer, satellites or roadside posts.

This invention equips a vehicle with an apparatus to record traffic information such as the driving speed and the path, to send the information to other passing-by vehicles through a transceiver, and to receive the information from those passing-by vehicles. It enables the vehicles equipped with this apparatus to collect and interchange traffic information during passing by, and to achieve navigation.

The composition and function of this invention will be expressed in company with the following figures.

An embodiment of this invention is described by way of example. With reference to the drawings in which:

Fig.1 shows an example of the invented method in which the traffic information of a first vehicle is transferred via a second vehicle to a third vehicle.

Fig.2 shows another example of the invented method in which the traffic information of one vehicle is transferred to another vehicle via two other vehicles.

Fig.3 shows a block diagram of an embodiment of the invented apparatus.

Fig.4 shows the outward of an indicator and a microcomputer of an embodiment of this invention.

Fig. 5 shows a functional diagram of a navigation unit in an embodiment of this invention.

As Fig. 1 shows, three vehicles a_1, a_2, and b equipped with the invented apparatus drive individually along two opposite paths X and Y in two adjacent roads A and B. The vehicle a_1 in the front of road A sends its traffic information, such as the driving path and speed, to the passing-by vehicle b at a position P_1. When the vehicle b passes by the vehicle a_2 in the rear of the road A at a position P_2 later, the traffic information of the vehicle a will then be sent to the vehicle a by the vehicle b. As a result, the vehicle a_2 obtains the traffic status (e.g. the average driving speed of a certain path) in front according to the information it gets.

The procedure mentioned above shows how a vehicle to sent information to another following vehicle behind at a distance through the medium of a vehicle on the adjacent path. In the same way, the vehicle b sends its traffic information to any vehicle behind it (not shown in the figure) through the medium of the vehicles a_1, a_2 on the adjacent road A. In other words, a vehicle with the invented apparatus collects not only the traffic information of its own but also that of other vehicles.

In practice, the distance of information transference among the passing-by vehicles (usually the vehicles are in a two-way road, cross roads, or forks of a road) is within a limited range, such as 200 meters, when the vehicles are

driving close. And, a vehicle which is closely behind a front vehicle need not receive the information of the front vehicle because the traffic status is visible. Therefore, a low power electromagnetic wave, infrared ray or laser transceiver that points to a certain direction (for the communication of two passing-by vehicles only) or functions in a specific range (such as only receives signals from other vehicles within the range of 135 degrees to the right and left sides of the driving direction) can be used.

Fig.2 shows an example of the vehicles transferring their traffic information successively. A vehicle f acquires the traffic information of a vehicle c through the help of vehicles d and e. The vehicle c driving along a path c_x sends its traffic information to the passing-by vehicle d in a position x_1. Later, the vehicle d driving along paths D_1, D_2, and D_3 sends its traffic information to a passing-by vehicle e driving along paths E_1 and E_2. Then the traffic information of the vehicle c carried by the vehicle e will be sent to the passing=by vehicle f in a position x_3. That is, the vehicle f along a path F will acquire the traffic status information of the front path C_x.

The content and the process of transference of traffic information are described as follows.

The vehicle had better be equipped with an electronic map device which can display digitized road map

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and identifies the position of the vehicle on the map. (The vehicle may have a direction sensor and a displacement sensor to record the movement of the vehicle. The movement data combined with the starting position once set by the driver can be applied to map the locus of the vehicle to the map utilizing a prior technology.) Based on the technology, the roads on the map are constructed by straight or curved lines linking between points. (A two way or a one way road can be represented by its center line. Taking Fig.2 as an example, the cross point N_2, the turning points N_1 and N_3 of the center lines are representative points of the roads.) All these points can be identified through their absolute coordinates (geological coordinates). Thus, the vehicle can be matched to the map by comparing its movement to the coordinates. For example, when the vehicle d in the path D_1 turns into the path D_2, the turning position will be mapped to the point N_1. (The sensed displacement of the vehicle will be revised if it differs from the map.) Also, the driving path D_1 of the vehicle d can be identified by the link of the points N_1 and N_2. For example, a vehicle drives through points N_1, N_2 and N_3, its traffic information can be described as follows:

<.....coordinates of N_1, average driving speed, the longest halting time, coordinates of N_2, average driving speed, the longest halting time, coordinates of N_3,.......>

Wherein, the average driving speed is the value of the mileage between two points divided by the driving time and it enables the apparatus to conjecture the traffic status whether in heavy traffic or not. The longest halting time is the longest time for a vehicle in the path while staying in an idle speed because of some reasons (such as encountering the red lights) which enables the apparatus to estimate the changing cycle of the traffic lights in the city. The process and usage will be described later.

To receive and transmit the traffic information, the vehicle can be equipped with a signal transceiver with prior technologies of infrared rays, laser or radio, or it can be adapted to a mobile phone for multiplexly executing the work. These are prior arts which need not to be described in detail.

The traffic information transferred among the vehicles includes the traffic information of the vehicle itself as well as of other vehicles. An example of the format of the transference is set as follows:

〈starting code, code of the vehicle itself, traffic information of the vehicle itself; code of another vehicle 1, self-traffic information of the vehicle 1; code of the other vehicle 2, self-traffic information of the vehicle 2;...; code of another vehicle n, self-traffic information of the vehicle n, ending code.〉

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The starting code and the ending code are set for the vehicle that receives the information (which will be mentioned as "receiving vehicle" hereafter) to identify the signal range. For the purpose of classifying and identifying the information, the codes of the vehicles can be the license numbers or other identification numbers. The vehicles 1 to n are those in front of the receiving vehicle. The self-traffic information of the vehicles 1 to n is previously received from the adjacent passing-by vehicles, temporarily stored and later transferred to the receiving vehicle. Any outdated information, such as the paths that the receiving vehicle has already passed, will be removed.

Fig. 3 shows the composition of an embodiment of the present invention . The main part is a microcomputer 1, including a self-position identifier 11 which receives the detected value of the above mentioned displacement sensor 2, direction sensor 3 and the map data 12 to identify the position of the vehicle --The position of the vehicle itself can be estimated by comparing the detected value with the map data 12; The differential, if any, will be revised when the vehicle changes its direction; The revision will be the reference for the following comparison; If the differential is beyond a certain range, it means there is a path not provided by the map data 12, then it can be ascertained by the driver and stored into the map; The driver, driving the

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vehicle in a straight road for over a certain mileage, will be reminded by the apparatus to ascertain the position of the car by punching a button to clear any differential when he arrives an evident position (such as a cross road). The traffic information of the vehicle itself is stored in a self-information register 13. The information in the register 13 can be processed by an output-information encoder 17 and sent out by a transmitter 7 as the first information of each transference as mentioned above. On the other hand, the traffic information from other vehicles is received by a receiver 4 and decoded by a decoder 14. Each first traffic information (of the vehicle itself that sends it out) will be stored in a "passing-by-vehicle information register" 16 and is provided the encoder 17 and the transmitter 7 to send out. The storage in the register 16 is updated in a process of first-in & first-out and removing any information of the path already behind the receiving vehicle. The rest of the received traffic information (other than the self information of the vehicle that sends it out), i.e., information of the vehicles in front of the receiving vehicle, will be received and stored in a "front-vehicle information register" 15. To avoid accumulating repeated information , the information is stored based on the codes of the vehicles and is timely updated. A navigation unit 18 fetches the data from the self-position identifier 11 and from the register 15, generates

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navigation information and sends it to an indicator 8. The composition and the operation of the navigation unit 18 and the indicator 8 will be described below.

Fig.4 shows the outward of an indicator and a microcomputer in an embodiment of this invention. The indicator 8 includes a liquid crystal display or a screen 81 to indicate the map and other navigation information. It can also be equipped with pilot lights 82 and a beeper or speaker 83 to provide warnings. The map data 12 can be stored in a compact disc (CD) and retrieved by a player 120 as shown, or a memory device (such as DRAM or SRAM) accessed by the microcomputer 1; it includes not only the road position information, road width, shape of intersections, but also the region names, road names, starting and ending numbers of the residence, driving limits (one-way street, speed limitation, etc.), and locations (including addresses and telephone numbers) of gas stations along the roadsides, restaurants and hotels, service stations, rest stations, offices, stores, and so on. The microcomputer 1 provides suitable user interfaces, such as a keyboard 10 as shown or screen-touch or verbal input units, to input commands or data--such as to contract or enlarge the map, to identify the position of the vehicle, to input the destination, etc. The composition of the navigation unit 18 set in the microcomputer 1 will be described by referring to Fig. 5.

Fig.5   shows   the   content   and   function   of   the
navigation   unit   18   which mainly   comprises   a   map-drawing
module   181   and   a navigation module   182.   The   map-drawing
module   181   generates   the   map and   displays   it   with   the
indicator   8   (on   the   screen 81 shown   in   Fig.4)   based   on
information 110 of the position and direction of the   vehicle
(identified by the self-position identifier 11 shown in   Fig.
3)   and the related map data 12. The map is displayed in   two
modes -- the geological direction (north-up) and the   vehicle
direction   (heading-up);   For instance, when the   position   of
the   vehicle   itself and the destination are   not   identified
yet,   the map is north-up and controlled by the user   through
interfaces (such as the keyboard 10 in Fig.4) to move upward,
downward,   left and right; When the vehicle is   driving,   the
map   is heading-up, i.e. the vehicle itself is stationary   in
the middle but a little bit low position of the display,   and
the   map   is   moving   and   rotating   accordingly.   The   size
(displayed area) of the map is adjustable, for example,   from
0.5*0.5   km,   3*3 km,   15*15 km,   100*100 km to 600*600   km,   by
the user's command or automatically by the apparatus based on
the relationship between the position of the vehicle and   the
destination--when   the destination is just identified, a   map
in a suitable scale that covers the vehicle location and   the
destination   will be shown when the vehicle is   driving,   the
size of the map can be contracted to a smaller area   (such as

3*3km); and when closing to the destination, it can be contracted to the smallest area to reveal the detail. (The scope for revealing the detail is related to the size and contained only the needed information for guiding the vehicle to the destination, therefore, unnecessary details are omitted in a larger size of map.)

The navigation module 182 provides functions of path indication, driving forecast and speed-control instruction. This module, after identifying the present position of the vehicle and its destination, searches for all the available paths based on road information, 121 (the speed limit, allowed directions, etc., which are parts of the map data 12) and front-vehicle information 151 (such as the average driving speed stored in the "front-vehicle information register" 15 as shown in FIG.3); calculates the driving times for all the available paths respectively, and constructs several better time-saving paths displayed on the map for reference. (the paths display either orderly by the user's command, or simultaneously in bold-medium-thin line or real-dotted line formats.) The module 182 also provides a gas-efficient selection by calculating the respective gas consumption for each path by multiplying its distance into the vehicle's gas consumption rate which is corresponding to the average driving speed. The above result, depending on the user's selection through key punching, can be constructed

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into several better-path displays based on gas consumption or time spent. The whole system, after turning on, will continuously receive traffic information sending by the passing-by vehicles and update the information 151; therefore, it may timely refresh aforesaid better-path displays at intervals, such as every 10 seconds. The already-passed path can be indicated by a flashing line. Also, the name of the passing roads and the cross roads in front should be timely updated with clear indication on the map. At a suitable time margin (depending on the driving speed) before the vehicle should turn in another direction, the module 182 will function the indicator 8 (with sound or light signal as warnings) to remind the driver to keep to the right or left lane, and display the distance before making the turn. The indicator 8 can also display the mileage still left, the estimated arriving-time, the still-needed amount of fuel, etc., depending on the driver's command. If the fuel is not sufficient, the indicator 8 will remind the driver and display the gas station near by and navigate. When the destination is near (for example, within 5 km), the display will start counting down the left time and mileage. The system can also suggest the cruising speed based on the traffic condition and the speed limit of each path and the desired arriving time input by the driver, At the path that needs to stop frequently due to traffic lights, the module

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182 will estimate the light changing cycle by checking the most frequent "longest halting time" among those of the front vehicles in the information 151, and further estimates the light changing time based on the position of the vehicle and its driving status, and then informs the driver to adjust the speed to prevent from stopping, and reminds (by displaying the left time) the driver to action in time upon the light changing.

A statistic module 183, according to the user,s command when he arrives in the destination, will compute and display, based on the self-vehicle information 131, the total driving time, mileage, average of driving speed, number of stops, time for stops, number of making turns, and number of passing-by vehicle that it has met.

The above embodiment explains the traffic information passing among the vehicles and the possible ways to use it. In practice, the traffic information can also be received through a receiving station, similar to the central computer system and transceiver posts mentioned before, then it is processed to generate required information including the positions of every vehicles, about traffic regulations, record of collecting tolls, query for those who need it, and so on. The traffic information can also offer driving navigation to those vehicles that only equip with receivers. These applications are also includes in the extent of the

appended claims.

CLAIMS

1. A system for many a vehicle to obtain traffic information from each other and using the information to self-navigate, wherein each vehicle is equipped with an apparatus comprising at least:

recording means to record traffic information concerning at least driving speed and locus of the vehicle itself and those of other vehicles;

a transmitter to send said information to other vehicles passing by;

a receiver to receive information from said passing-by vehicles; control means to process the information for said recording means, said transmitter and receiver, and to generate navigation information; and

an indicator to show said navigation information.

2. A system for many a vehicle to obtain traffic information from each other and using the information to self-navigate, wherein each vehicle is equipped with an apparatus comprising:

a map device to provide digitized map data;

a direction sensor and a displacement sensor to monitor the movement of the vehicle itself;

a transmitter and a receiver to transmit and

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receive traffic information;

a microcomputer comprising;

a user-interface to receive command and data input from the user;

a self-position identifier to receive data from said map device; said direction sensor, displacement sensor and said user-interface to identify the position of the vehicle;

a self-information register to store traffic information of the vehicle itself;

a decoder to decode information received by said receiver into two parts as "passing-by-vehicle information" and "front-vehicle information";

a "passing-by-vehicle information register" to store said passing-by -vehicle information;

a "front-vehicle information register" to store said front-vehicle information;

an output-information encoder to process the information from said self-information register and said passing-by-vehicle information register and to sent to said transmitter; and

a navigation unit to fetch data from said map device, said self-position identifier, said user-interface and said front-vehicle information register and to produce navigation information; and

an indicator to show said navigation information.

3. A system of claim 2 wherein said navigation unit comprising at least one of the following three modules:

a map-drawing module to generate dynamic maps, according to data of said map device, said user-interface and said self-position identifier, to display on said indicator in suitable scales;

a navigation module to provide path-indication, driving-forecast and speed-control instruction, in which

said path-indication provides displays of: several better paths for the vehicle to approach its destination based on gas consumption, and time spent predicted from received traffic information, locus of the vehicle, name of roads, and warnings before the vehicle should turn in another direction;

said driving-forecast provides displays of : mileage still left, estimated arriving-time, still-needed amount of fuel, warning and guiding to a suitable gas station when fuel is not sufficient, and counting-down left time and mileage when destination is near;

said speed-control instruction provides displays of: suggested cruising speed based on received traffic information, data of said map device and user-input desired arriving time; and suggestion of driving speed to

prevent from stopping by traffic lights and reminding for traffic-light changing estimated by checking said front-vehicles information;

a statistic module to compute and provide displays of : total driving time, mileage, average of driving speed, number of stops, time for stops, number of making turns, and number of passing-by vehicles that the vehicle has met, according to user's command when arriving in the destination.

4. A system of claim 2 wherein said traffic information transferring among vehicles, including traffic information of the vehicle itself and that of other vehicles, is set in a format as:

<starting code, code of the vehicle itself, self-traffic information of the vehicle itself; code of another vehicle 1, self-traffic information of the vehicle 1; code of another vehicle 2, self-traffic information of the vehicle 2; ...; code of another vehicle n, self-traffic information of the vehicle n, ending code.>

Wherein said starting code and said ending code are set for the vehicle that receives the information to identify the signal range, said codes of vehicles are their identification numbers, said self-traffic information of the vehicle itself and of the vehicles 1 to n are information fetched from said self-information register and said front-

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vehicle information register respectively.

5. A system of claim 2 wherein said traffic information of each vehicle can be described as:

<...coordinates of N_1 , average driving speed, the longest halting time, coordinates of N_2, average driving speed, the longest halting time, coordinates of N_3,...>

Wherein said N_1 ,N_2,N_3,... are representative points of the locus; said average driving speed, which is the value of the mileage between two points divided by the driving time, enables the system to conjecture the traffic status whether in heavy traffic or not; said longest halting time, which is the longest time for the vehicle stopping in the path, enables the system to estimate the changing cycle of traffic lights in a city.

6. A system of claim 1 further comprises at least a transceiver station to receive and process the traffic information to generate required information about traffic regulations, record of collecting tolls, navigation to vehicles and query for those who need it.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

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Relevant Technical fields

(i) UK CI (Edition   K   )   G4Q (QAJ, QCF)

(ii) Int CI (Edition   5   )   G08G

Databases (see over)

(i) UK Patent Office

(ii)

Search Examiner

M J DAVIS

Date of Search

28.1.91

Documents considered relevant following a search in respect of claims   1-6

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	US 4706086 (PANIZZA) see whole document	1

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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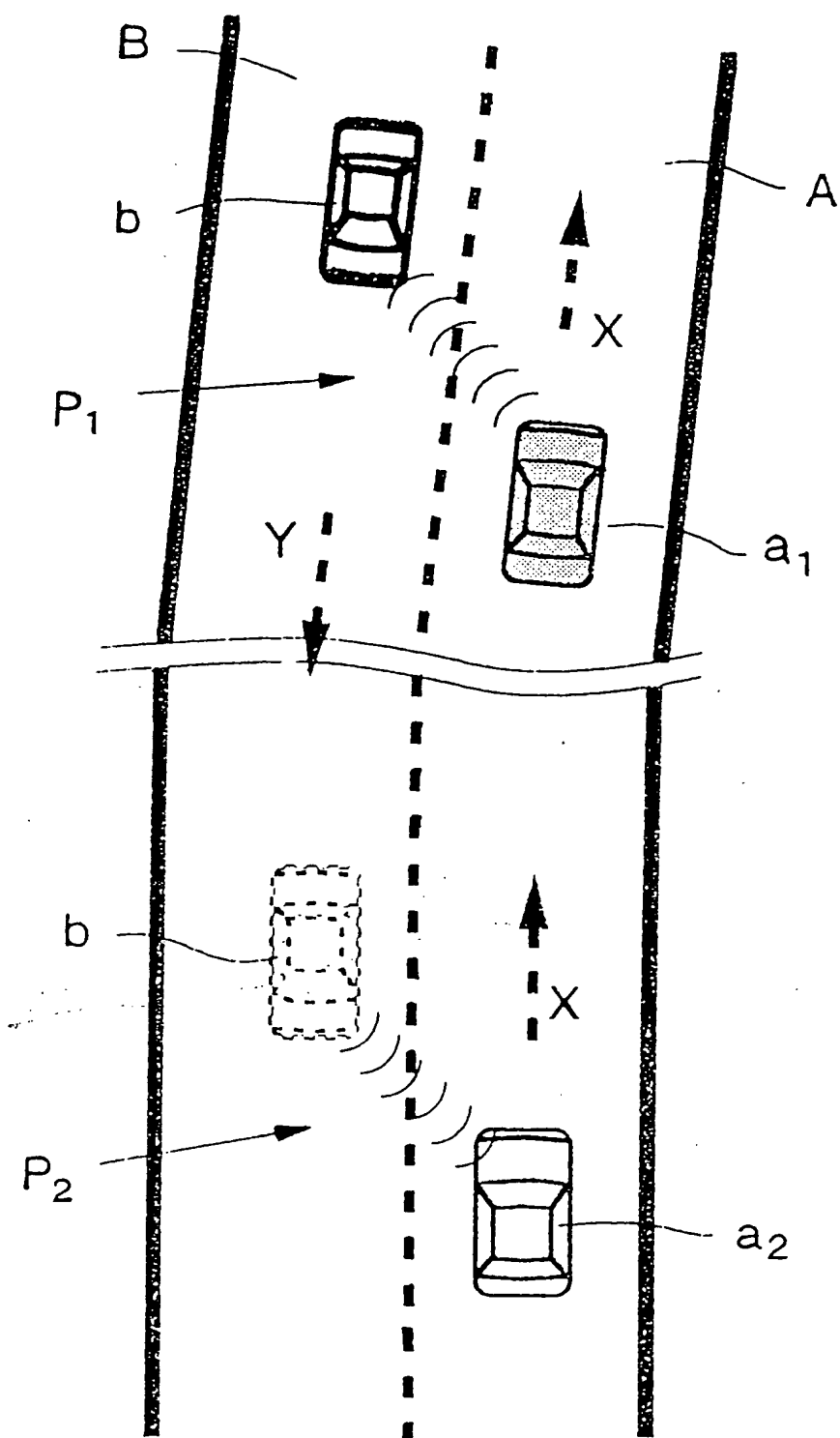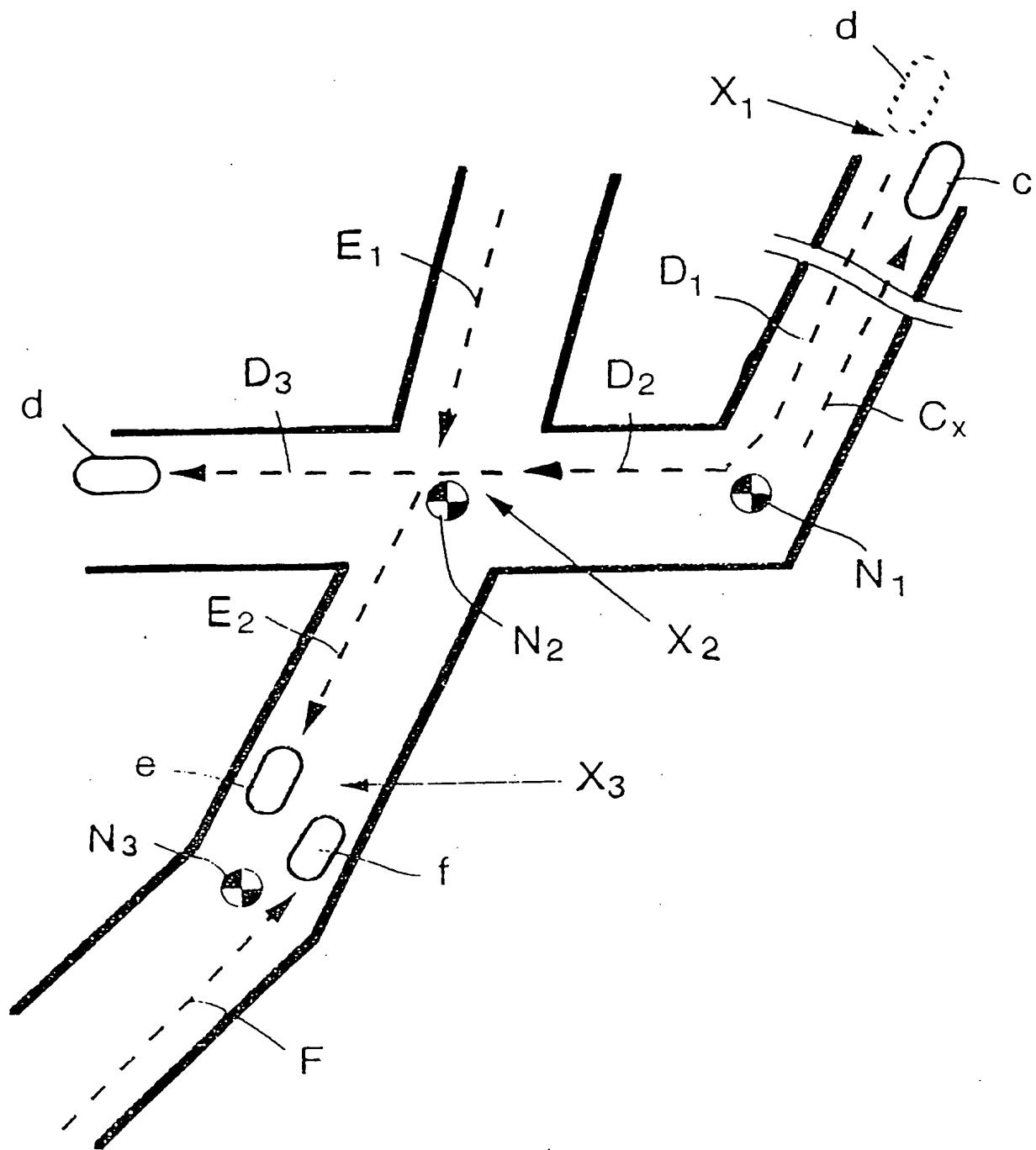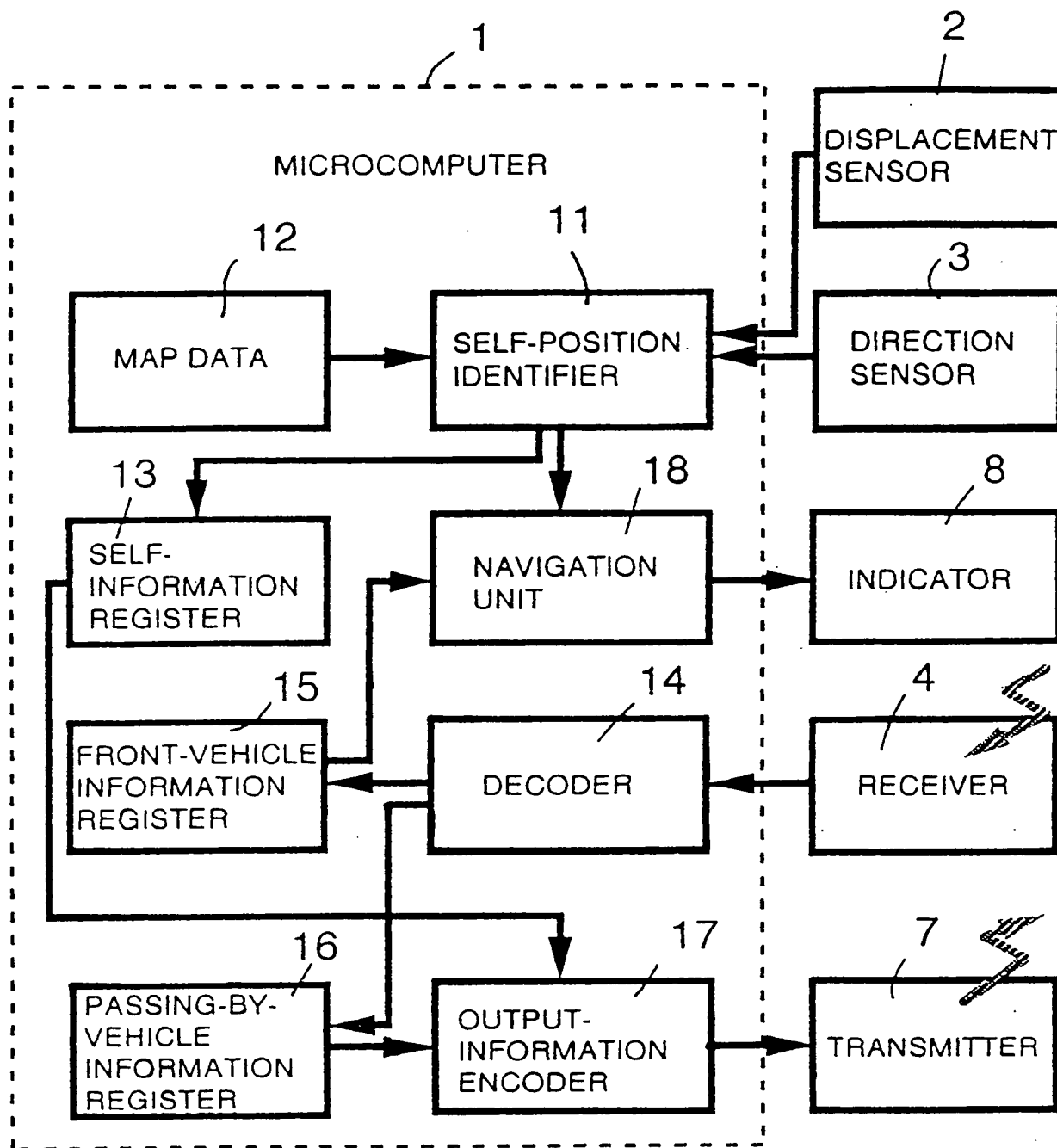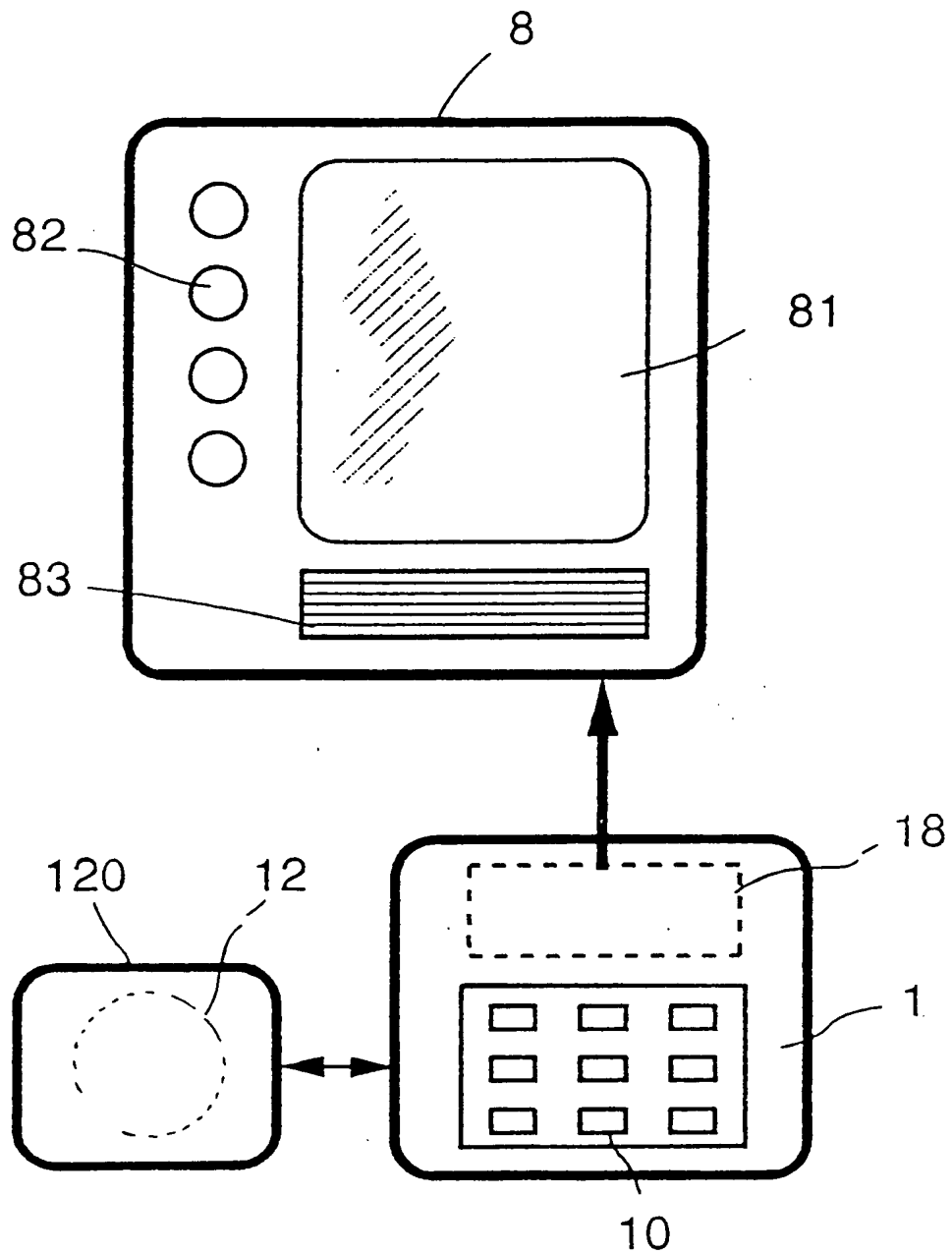
FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5